

**WHAT IS CLAIMED:**

1. A transgenic monocot plant transformed with a nucleic acid encoding an enzyme for trehalose biosynthesis, under control of an inducible promoter, that confers low temperature stress, salt stress, or water stress tolerance to the plant.
2. The transgenic monocot plant according to claim 1, wherein said monocot plant is selected from the group consisting of rice, wheat, maize (corn), barley, oat, rye, millet, and sorghum.
3. The transgenic monocot plant according to claim 2, wherein said monocot plant is a rice plant.
4. The transgenic monocot plant according to claim 2, wherein said monocot plant is a wheat plant.
5. The transgenic monocot plant according to claim 1, wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate synthase.
6. The transgenic monocot plant according to claim 5, wherein said trehalose-6-phosphate synthase is encoded by an *E. coli otsA* gene.
7. The transgenic monocot plant according to claim 1, wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate phosphatase.
8. The transgenic monocot plant according to claim 7, wherein said trehalose-6-phosphate phosphatase is encoded by an *E. coli otsB* gene.
9. The transgenic monocot plant according to claim 1, wherein transgenic monocot plant is additionally transformed with a second nucleic acid encoding an enzyme for trehalose biosynthesis.

10. The transgenic monocot plant according to claim 1, wherein transgenic monocot plant is transformed with a trehalose-6-phosphate synthase/trehalose-6-phosphate phosphatase fusion gene.

5

11. The transgenic monocot plant according to claim 1, wherein said inducible promoter is a stress-inducible promoter or a light-inducible promoter.

12. The transgenic monocot plant according to claim 11, wherein  
10 the inducible promoter is a stress-inducible and an abscisic acid-inducible promoter.

13. The transgenic monocot plant according to claim 11, wherein the inducible promoter is a light-inducible, RbcS promoter.

14. A transgenic monocot plant according to claim 1, wherein said  
15 transgenic monocot plant includes a nucleic acid encoding a selectable marker.

15. A seed produced by the transgenic monocot plant of claim 1.

16. A seed, which upon germination, produces the transgenic  
20 monocot plant of claim 1.

17. A monocot plant cell or protoplast transformed with a nucleic acid encoding an enzyme for trehalose biosynthesis, under control of an inducible  
25 promoter, that confers low temperature stress, salt stress, or water stress tolerance on a monocot plant regenerated from said monocot plant cell or protoplast.

18. The monocot plant cell or protoplast according to claim 17,  
wherein said monocot plant cell or protoplast is derived from a plant selected from the  
30 group consisting of rice, wheat, maize (corn), barley, oat, rye, millet, and sorghum.

19. The monocot plant cell or protoplast according to claim 18,  
wherein said monocot plant cell or protoplast is derived from a rice plant.

20. The monocot plant cell or protoplast according to claim 18,  
5 wherein said monocot plant cell or protoplast is derived from a wheat plant.

21. The monocot plant cell or protoplast according to claim 17,  
wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate synthase.

10 22. The monocot plant cell or protoplast according to claim 21,  
wherein said trehalose-6-phosphate synthase is encoded by an *E. coli otsA* gene.

23. The monocot plant cell or protoplast according to claim 17,  
wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate phosphatase.

15 24. The monocot plant cell or protoplast according to claim 23,  
wherein said trehalose-6-phosphate phosphatase is encoded by an *E. coli otsB* gene.

25. The monocot plant cell or protoplast according to claim 17,  
20 wherein the monocot plant cell or protoplast is additionally transformed with a second  
nucleic acid encoding an enzyme for trehalose biosynthesis.

26. The monocot plant cell or protoplast according to claim 17,  
wherein the monocot plant cell or protoplast is transformed with a trehalose-6-  
25 phosphate synthase/trehalose-6-phosphate phosphatase fusion gene.

27. The monocot plant cell or protoplast according to claim 17,  
wherein said inducible promoter is a stress-inducible promoter or a light-inducible  
promoter.

30 28. The monocot plant cell or protoplast according to claim 27,  
wherein the promoter is a stress-inducible and an abscisic acid-inducible promoter.

29. The monocot plant cell or protoplast according to claim 27,  
wherein the promoter is a light-inducible, RbcS promoter.

5                   30. The monocot plant cell or protoplast according to claim 17,  
wherein said monocot plant cell or protoplast includes a nucleic acid encoding a  
selectable marker.

                  31. A transgenic monocot plant regenerated from the monocot  
10 plant cell or protoplast of claim 17.

                  32. The transgenic monocot plant according to claim 31, wherein  
said transgenic monocot plant is a rice plant.

15                   33. The transgenic monocot plant according to claim 31, wherein  
said transgenic monocot plant is a wheat plant.

                  34. A seed produced by the transgenic monocot plant of claim 31.

20                   35. The seed produced by the transgenic monocot plant according  
to claim 34, wherein the transgenic monocot plant is a rice plant.

                  36. The seed produced by the transgenic monocot plant according  
to claim 34, wherein the transgenic monocot plant is a wheat plant.

25                   37. A transgenic monocot plant regenerated from the monocot  
plant cell or protoplast of claim 25.

                  38. The transgenic monocot plant according to claim 37, wherein  
30 said transgenic monocot plant is a rice plant.

39. The transgenic monocot plant according to claim 37, wherein said transgenic monocot plant is a wheat plant.

40. A seed produced by the transgenic monocot plant of claim 37.

5

41. The seed produced by the transgenic monocot plant according to claim 40, wherein the transgenic monocot plant is a rice plant.

42. The seed produced by the transgenic monocot plant according to claim 40, wherein the transgenic monocot plant is a wheat plant.

10

43. A transgenic monocot plant regenerated from the monocot plant cell or protoplast of claim 26.

15

44. The transgenic monocot plant according to claim 43, wherein said transgenic monocot plant is a rice plant.

45. The transgenic monocot plant according to claim 43, wherein said transgenic monocot plant is a wheat plant.

20

46. A seed produced by the transgenic monocot plant of claim 43.

47. The seed produced by the transgenic monocot plant according to claim 46, wherein the transgenic monocot plant is a rice plant.

25

48. The seed produced by the transgenic monocot plant according to claim 46, wherein the transgenic monocot plant is a wheat plant.

49. A method of conferring low-temperature stress, water stress, or salt stress tolerance to a monocot plant comprising:

30

transforming a monocot plant cell or protoplast with a nucleic acid encoding an enzyme for trehalose biosynthesis under conditions effective to confer

low temperature stress, salt stress, or water stress tolerance to monocot plants produced from the monocot plant cell or protoplast.

50. The method according to claim 49, wherein said monocot plant  
5 cell or protoplast is derived from a plant selected from the group consisting of rice, wheat, maize (corn), barley, oat, rye, millet, and sorghum.

51. The method according to claim 50, wherein said monocot plant  
10 cell or protoplast is derived from a rice plant.

52. The method according to claim 50, wherein said monocot plant  
cell or protoplast is derived from a wheat plant.

53. The method according to claim 49, wherein the enzyme for  
15 trehalose biosynthesis is trehalose-6-phosphate synthase.

54. The method according to claim 53, wherein said trehalose-6-  
phosphate synthase is encoded by an *E. coli otsA* gene.

55. The method according to claim 49, wherein the enzyme for  
20 trehalose biosynthesis is trehalose-6-phosphate phosphatase.

56. The method according to claim 55, wherein said trehalose-6-  
phosphate phosphatase is encoded by an *E. coli otsB* gene.

25 57. The method according to claim 49 further comprising:  
transforming the monocot plant cell or protoplast with a second nucleic  
acid encoding an enzyme for trehalose biosynthesis.

30 58. The method according to claim 49, wherein the monocot plant  
cell or protoplast is transformed with a trehalose-6-phosphate synthase/trehalose-6-  
phosphate phosphatase fusion gene.

59. The method according to claim 49, wherein said transforming comprises:

propelling particles at said monocot plant cell under conditions  
5 effective for the particles to penetrate the cell interior; and  
introducing a plasmid comprising the nucleic acid encoding an enzyme  
for trehalose biosynthesis into the cell interior.

60. The method according to claim 59, wherein the plasmid is  
10 associated with the particles, whereby the plasmid is carried into the cell or protoplast  
interior together with the particles.

61. The method according to claim 49, wherein said transforming  
comprises:  
15 contacting tissue of the monocot plant with an inoculum of a bacterium  
of the genus *Agrobacterium*, wherein the bacterium is transformed with a plasmid  
comprising the nucleic acid encoding an enzyme for trehalose biosynthesis.

62. The method according to claim 49 further comprising:  
20 regenerating the transformed monocot plant cell or protoplast to form a  
transgenic monocot plant.

63. A transgenic monocot plant produced by the method of  
claim 62.

25 64. A seed produced by the transgenic monocot plant of claim 63.

65. A method of increasing tolerance of a monocot plant to low-  
temperature stress, salt stress, or water stress conditions, said method comprising:  
30 increasing levels of an enzyme for trehalose biosynthesis in said  
monocot plant.

66. The method according to claim 65, wherein said monocot plant is selected from the group consisting of rice, wheat, maize (corn), barley, oat, rye, millet and sorghum.

5 67. The method according to claim 66, wherein said monocot plant is a rice plant.

68. The method according to claim 66, wherein said monocot plant is a wheat plant.

10

69. The method according to claim 65, wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate synthase.

70. The method according to claim 69, wherein said trehalose-6-phosphate synthase is encoded by an *E. coli otsA* gene.

15

71. The method according to claim 65, wherein the enzyme for trehalose biosynthesis is trehalose-6-phosphate phosphatase.

20 72. The method according to claim 71, wherein said trehalose-6-phosphate phosphatase is encoded by an *E. coli otsB* gene.

73. A transgenic monocot plant transformed with a plasmid that confers low temperature stress, salt stress, or water stress tolerance to the monocot plant, said plasmid comprising:

25

a first nucleic acid encoding trehalose-6-phosphate synthase;  
a first inducible promoter, said promoter located 5' to said first nucleic acid and controlling expression of said first nucleic acid; and  
a first termination sequence located 3' to said first nucleic acid.

30

74. The transgenic monocot plant of claim 73, wherein said plasmid further comprises:



a second nucleic acid encoding trehalose-6-phosphate phosphatase, said second nucleic acid located 3' to said first inducible promoter controlling expression of said second nucleic acid, 3' to said first nucleic acid, and 5' to said first termination sequence.

5

75. The transgenic monocot plant of claim 74, wherein said second nucleic acid is fused with said first nucleic acid and coexpressed under control of said first inducible promoter.

10

76. The transgenic monocot plant of claim 73, wherein said plasmid further comprises:

a third nucleic acid encoding a selectable marker, said third nucleic acid located 3' to said first termination sequence;

15 a second promoter located 5' to said third nucleic acid and 3' to said first termination sequence, said second promoter controlling expression of said third nucleic acid; and

a second termination sequence located 3' to said third nucleic acid.

20

77. The transgenic monocot plant of claim 73, wherein said inducible promoter is a stress-inducible promoter or a light-inducible promoter.

25

78. The transgenic monocot plant of claim 77, wherein the promoter is a stress-inducible and abscisic acid-inducible promoter.

79. The transgenic monocot plant of claim 77, wherein the promoter is a light-inducible, RbcS promoter.

30 80. The transgenic monocot plant of claim 76, wherein the plasmid is designated pSB109-TPSP.

81. The transgenic monocot plant of claim 76, wherein the plasmid is designated pSB-RTSP.

82. The transgenic monocot plant of claim 80, wherein the  
5 inducible promoter is a stress-inducible and abscisic acid-inducible promoter.

83. The transgenic monocot plant of claim 81, wherein the promoter is a light-inducible, RbcS promoter.